

# Use of Mathematical Optimization to Derive Personalized Dietary Recommendations

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*Publication date:*
2018

*Document Version*
Version created as part of publication process; publisher's layout; not normally made publicly available

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Consumption patterns in a population often vary greatly and national dietary guidelines may be perceived as unrealistic by a substantial part of the population, as they differ considerably from individual preferences. Personalized recommendations may be more relevant and have stronger motivational effects, because these can account for e.g. personal preferences, needs, and beliefs. Hence, personalized recommendations may have a positive impact on public health, since higher compliance to the recommendations can be expected.

We developed a method for modelling personalized dietary recommendations. The method is applied to estimate optimized fish intake in Denmark, taking into account maximum levels of chemical contaminants and minimum levels of nutrients in different fish species.

A mathematical optimization model that applies quadratic programming was used to model personalized fish intake recommendations that deviate as little as possible from observed individual fish intake. Model constraints ensure that modelled intake levels meet the general recommendations for eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and vitamin D without violating the tolerable intake recommendations for methyl mercury, dioxins, and dioxin-like polychlorinated biphenyls. Recommendations for eleven fish species were generated for each individual in a group of 3,016 Danish adults, whose fish intakes and body weights were recorded in a national dietary survey.

Our results suggest that 55 % of the study population should be recommended to increase their intake of fish with up to 184 g/week (24 % with more than 100 g/wk) and that 2 % should be recommended to decrease their fish intake.

Our method is appropriate for translating recommendations for single nutrients and contaminates into personalized dietary recommendations, thanks to its multidimensional property. The method has great potential for evolving dietary guidelines by accounting for personal preference, and it can also be extended to include economy and sustainability.